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Room Temperature Terahertz Detection based on Electron Plasma Resonance in an Antenna-Coupled Gallium Arsenide MESFET

SANGWOO KIM, Phys. Dept., UCSB, JERAMY ZIMMERMAN, Materials Dept., UCSB, PAOLO FOCARDI, Jet Propulsion Lab, Pasadena, CA, DONG HO WU, Naval Research Lab, Washington, D.C., ARTHUR C. GOSSARD, Materials Dept., UCSB, MARK S. SHERWIN, Phys. Dept., UCSB — Terahertz detectors utilizing quantum transitions require cryogens since the thermal energy (kT) needs to be smaller than the transition energy (1 THz $\sim$ 4 meV). A bulk 3-D plasmon is a classical excitation, and hence does not saturate with temperature. Plasma absorptions occur at a density-dependent frequency $1/2\pi\sqrt{n_{3D}e^2/m\varepsilon}$. For 1 THz radiation, the corresponding 3-D free electron density is $n_{3D} \sim 10^{16}$ cm^{-3} in GaAs, a density that can be easily achieved. The density of electrons can be made tunable if a device such as a Field Effect Transistor is employed. We utilize these facts in order to realize a room temperature Terahertz detector. Our device consists of twin-slot antennas, coplanar waveguides, and a GaAs Metal-Semiconductor-Field-Effect-Transistor (MESFET). While the sensitivity of the first set of devices is not competitive, we were able to observe the resonance behavior by sweeping bias voltages. This talk will present design, fabrication, recent measurement, and possible future improvement of our detector. Work supported by NSF-DMR 0703925 and Naval Research Lab.

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